THE HEAVY SNOWSTORM OF JANUARY 28-30, 1953 AT THE EASTERN END OF LAKE ONTARIO

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The occasionally important influence of local geographical features on weather happenings is dramatically illustrated in the locally heavy snowfalls which occur to the lee of the Great Lakes during the autumn and winter months. On the night of January 28–29, 1953, such a snowfall occurred in and around Pulaski, N. Y., a few miles from the eastern shore of Lake Ontario (see fig. 2) with depths of new snow as much as 3 feet being reported overnight. The snowfall occurred within a very narrow east-west band 15 to 20 miles wide.

The purpose of this article is to set forth some of the synoptic features of the weather situation accompanying this storm and its counterparts which subsequently during the immediately following 24 hours produced snowfalls of 9 inches or more in two other sections of the "eastern-end" region of New York State. Wiggin [1] reports that in January 1940 a snowburst of this type buried the eastern end of Lake Ontario's countryside and shoreline under 8 feet of snow which was blown later into drifts 20 feet high. He also states that this region, which extends roughly from Syracuse northward to Watertown, N. Y., and eastward to the Adirondack Mountains, receives more snowfall than any other area of the United States east of the Rockies.

Remick [2] describes the frictional and thermal influences on cold air currents which pass over the warmer lakes but states that Lake Erie is often ice covered in late winter and does not, therefore, produce these locally heavy snows late in the winter. Lake Ontario, however, is a much deeper lake and remains open during the entire winter.

Lansing [3] in describing heavy local snows at the eastern end of Lake Ontario states that if the winds are predominantly from the southwest, given the other necessary conditions, the Adams-Watertown area may get the snow; if westerly, the Pulaski-Sandy Creek area eastward to the Adirondacks; and if northwesterly, the Fulton-Syracuse area. Thus with a series of fast moving Lows, with winds shifting from southwest to west and from west to northwest snow could continue over this area for 2 or 3 days with each different wind component "spraying" the leeward area with bursts of snow.

A storm of this type comes into existence when a low pressure center passes northeastward across the Lakes and moves into the Canadian Provinces east of Hudson Bay and north of the St. Lawrence, where deepening occurs with partial blocking to the east. Accompanying this there must be a rather vigorous polar outbreak into the Mississippi Valley. This condition produces a flow of air across the lake. Repeated micro pressure troughs circulate around the great vortex of the low pressure system bringing about the shifting winds.

The heavy snows of January 28–30, when carefully analyzed, appear to be four separate snowstorms, affecting four different but partially overlapping regions in rapid succession accurately duplicating Lansing's model. The first snowfall was associated with a fresh outbreak of polar air which moved over Lake Ontario on January 28. (See fig. 1.) In the Pulaski, N. Y., area the snow began to fall during the evening of the 28th and continued all night. Reports of local residents indicated that up to three feet of snow had fallen at nearby Fernwood during the night, while 2 feet accumulated at Pulaski. Overnight snowfall amounts on this area are shown in figure 2 which has been reconstructed from all available information including that reported in local newspapers. (Note Stage I in fig. 2.)

However, at approximately 0700 EST of the 29th the snowbelt began to reorient itself toward the east-northeast and as the weather cleared in the Pulaski area, up to nine inches of snow fell by 1500 EST in a belt which includes Adams, N. Y., illustrated as Stage II in figure 2. The change in the general flow pattern in the lower levels of the atmosphere over and to the lee of the lake are indicated in the wind data for 2,000 feet as reported at Syracuse, N. Y. At 1600 and 2200 EST of the 28th and through 0400 EST of the 29th, the pibal at Syracuse showed a westerly wind at that level ranging from 26 to 43 knots. However, sometime between the 0400 and the 1000 EST pibal observations of the 29th, the winds shifted and came in from the southwest. The 1000 EST pibal for Syracuse shows a 14-knot wind from 240° at 2,000 feet. A glance at figure 2 shows the relatively longer lake trajectory experienced by a westerly wind reaching the Pulaski area

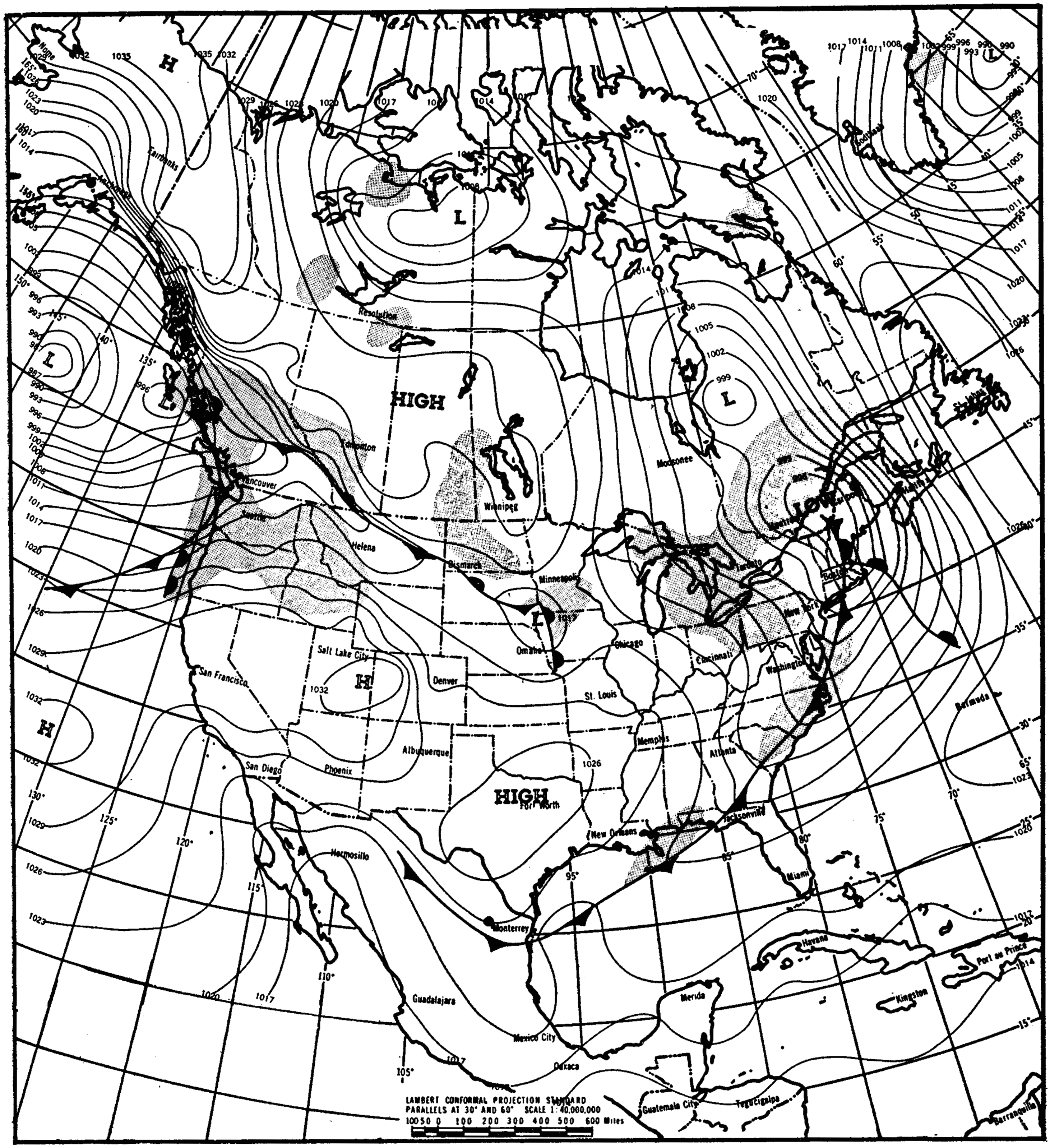

FIGURE 1.—Surface weather map for 1330 EST, January 28, 1953. Snow began to fall in the Pulaski, N. Y., area on the evening of this day and continued all night. (See Stage I in fig. 2.)

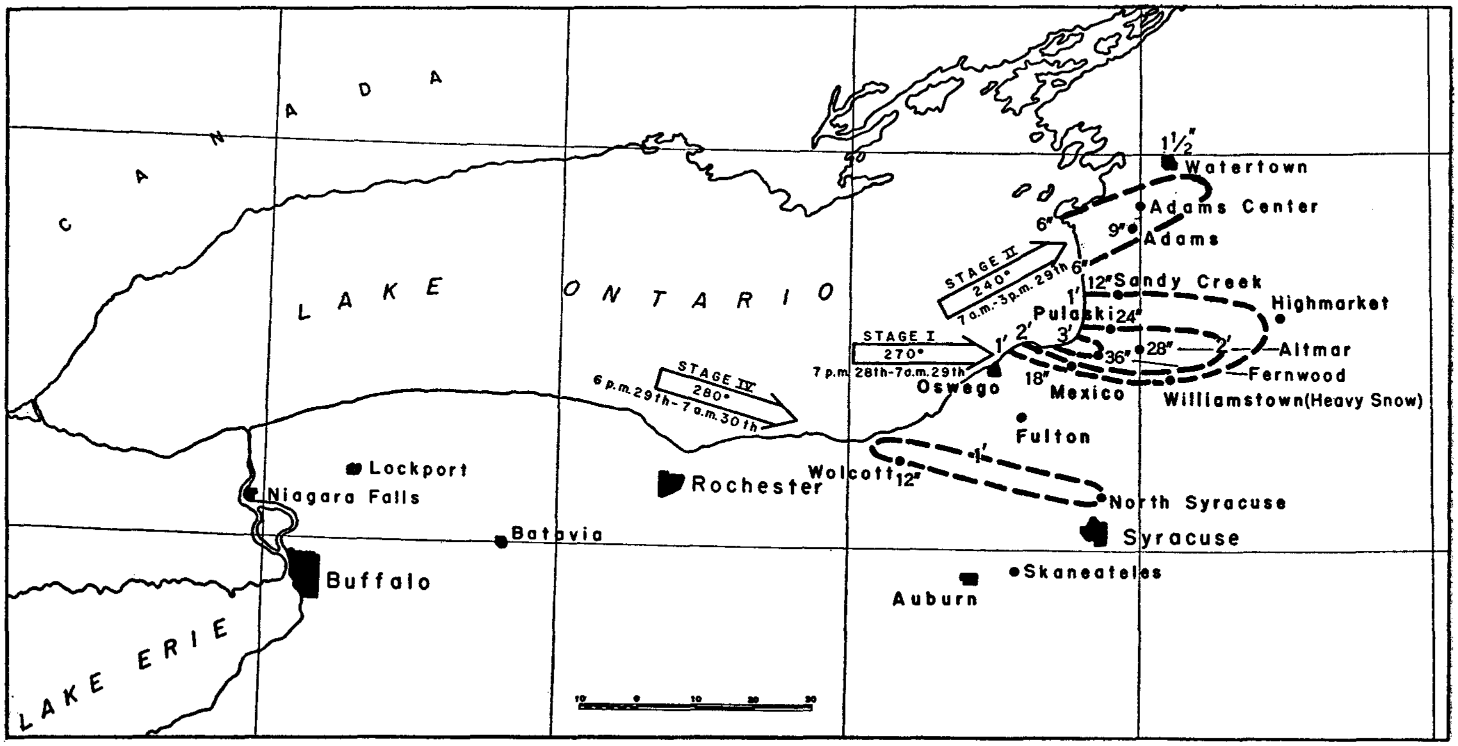

FIGURE 2.—Snowfall amounts accumulated in Stages I, II and IV of this storm over the "eastern end" region of New York State.

as compared with that associated with a southwesterly wind. It similarly reveals how a southwesterly wind produces the longer lake trajectory for air entering the Adams-Watertown area.

Between 1500 and 1600 EST of the 29th a sudden wind shift to the northwest occurred along the entire eastern shore of Lake Ontario. The snow-squalls produced by this shift prevented a pibal at Syracuse which would show the shift. Nevertheless, it is clearly indicated in the surface reports for the area, particularly for Oswego, N. Y. The accompanying snowburst brought 6 inches of new snow within a 3-hour period at Pulaski, Altmar, and Mexico, N. Y. The great amount of air-mass instability which accompanied this wind shift and resulted in the heavy snowfall is revealed by the thunder and lightning which were observed at Oswego at 1600 EST. Two inches of snow fell during this brief period at Oswego during what is described as a blinding snowstorm. (Stage III, not shown.)

These three storms, which are perhaps better termed three stages of a single storm, were followed by a fourth during the night of January 29–30 when another foot of snow fell in a narrow band which extended inland from the lake between Fulton and Syracuse. (Shown as Stage IV in fig. 2.) During this stage of the storm there was, of course, no pibal run at Syracuse, but the 0400 EST observation at Rome, N. Y., of the wind at 2,000 feet shows a 15-knot wind from 280°. An inspection of figure 1 again confirms the necessity for a sustained wind from this direction in order to produce a sufficient trajectory of the air over water.

Thus we find that except for Stage III, the snow associated with this storm apparently fell in narrow cell-like patterns in agreement with the model suggested by Wiggin [1] and in accordance with Lansing's directional scheme [3]. However, there is some indication that the vertical motion associated with the present case was in part due to the general synoptic situation. A microanalysis of the sea-level pressure field in this vicinity during the major portion of the snowfall shows a weak low-pressure disturbance moving from Sault Ste. Marie, Mich., to central Vermont during the 18 hours ending at 1930 EST of the 29th, passing just to the north of Lake Ontario around noon. This disturbance is shown in part on the synoptic chart for 1330 EST of January 29 (fig. 3). On this chart can also be found the Low which was located near Omaha, Nebr., at 1330 EST of January 28 (fig. 1). In figure 3 it is seen merely as a trough over eastern Pennsylvania, but a careful micropressure analysis shows it to be still a closed Low centered over Binghamton, N. Y.

Of major interest to meteorologists concerned with forecasting storms of this kind is the temperature contrast between the air and water necessary to produce such snows. Remick [2] lists the contrasts associated with five outstanding local snows near Lake Erie. They range from 16° to 29° F. with the air temperatures ranging from 32° down to 18° F. Forecasters in the area are

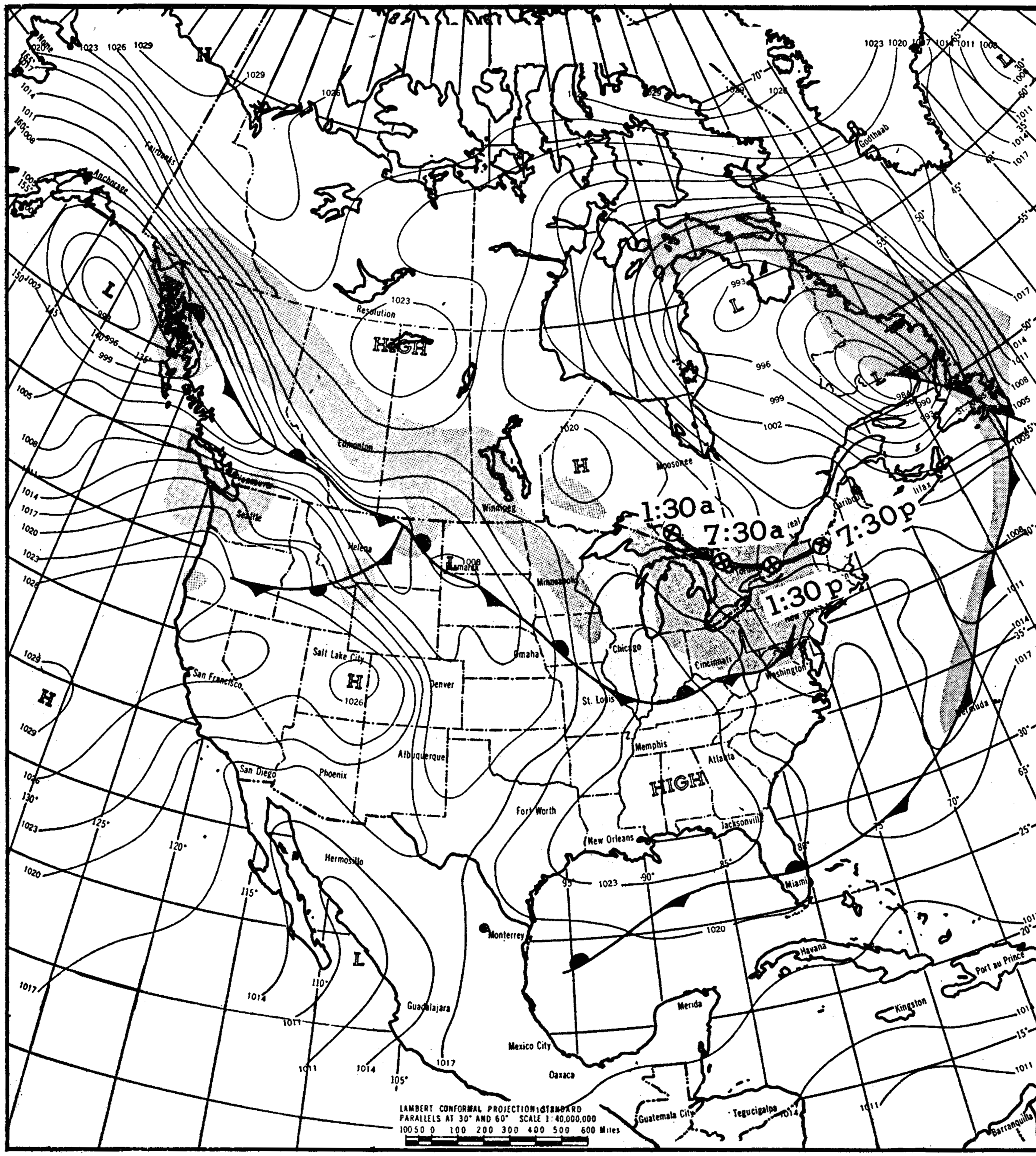

Figure 3.—Surface weather map for 1330 EST, January 29, 1953. (Stage II, see fig. 2.) Track shows positions of weak low pressure system which traversed the area. Another snowfall occurred during the night of January 29–30. (See Stage IV, fig. 2.)

of the opinion that a 10° contrast is sufficient. In the present instance the surface temperature of Lake Ontario was near 37° F. and the air temperature around 25° after its passage across the lake. There is also the question of the necessary lapse rate. Here it appears, according to Wiggin [1] that a lapse rate at the lee shore which is either as much or greater than the dry adiabatic lapse rate through a depth of more than 5,000 feet is necessary to produce the snow.

One of the most interesting features of this snow which falls to the lee of the Great Lakes due to passage of air across the lake, as compared with snow which falls from higher levels in cyclonic disturbances, is its comparative lesser density. Whereas the usual ratio of snow depth to water equivalent in the latter type of snow is 10 to 1, that for the type of snow which fell in this storm which occurred east of Lake Ontario is likely to be 30 to 1 [2]. Snow as light and fluffy as this, wherein it would take 30 inches of snow to make 1 inch of water is, according to Lansing [3], subject to severe blowing and drifting, visibility being at or near zero for hours at a time and on occasion up to 24 hours. Newspaper accounts of this snow as it affected the Pulaski area state that in the earliest phases of Stage 1 the snow was wet and heavy while the last portion was light and fluffy. It is perhaps not too far afield to speculate that the light fluffy snow is snow which has fallen soon after its formation and crystalization and has not had an opportunity to melt, as compared with cyclonic snow which often has had an opportunity to undergo some melting before reaching the ground. This, of course, is not true of cyclonic snows which fall during periods of very low temperature and such snows are also known to be of low density.

Since it appears from the analysis of this storm of January 28–30, 1953, and from the analysis of others previously referred to, that the entire life history of the snow which falls in such copious amounts takes place within a space which is approximately 200 miles in length and considerably narrower in width, this region at the eastern end of Lake Ontario is ideally suited for the establishment of a laboratory for the study of condensation and precipitation processes. It is also possible that the entire life cycle of some of the snowflakes from the time they leave the lake as water vapor thence to be condensed and fall as snow may take place within a very few feet above the lake and land surface. A similar suggestion was made to the authors two years ago by Mr. B. L. Wiggin, Meteorologist in Charge of the Weather Bureau Office in Buffalo, who considered the region around Buffalo suitable for such a laboratory.

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